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Non-marine Razorback Beds of Lower Jurassic age can be recognized forming the Razorback Mountains immediately behind the Mount Morgan smelter stack. This conspicuous topographic expression stands in sharp contrast to the down-faulted, negative topography exhibited by the Stanwell Coal Measures in the vicinity of Stanwell. Stanwell is located to the northwest, midway between the fiducial marks and the right edge of the photograph. Clearly visible are the Mount Morgan open cut, the dumps, and the tailings. (Photographed by Adastra Airways Pty. Ltd. on 21 September 1959. Reproduced by courtesy of Mount Morgan Limited.)

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PALYNOLOGICAL AND LITHOSTRATIGRAPHIC FEATURES OF THE RAZORBACK BEDS, MOUNT MORGAN DISTRICT, QUEENSLAND

ABSTRACT. Non-marine Mesozoic sediments, known as the Razorback Beds, unconformably overlie Palaeozoic ore-bearing rocks in the Mount Morgan district of east-central Queensland. The Razorback sequence consists largely of protoquartzite sandstones, which are extensively cross-stratified; intercalations of silty claystones and conglomerates are common in the basal portion. A representative measured section is detailed in this paper.

A palynological assemblage from the Razorback sediments is recorded and illustrated here for the first time. It includes spores and pollen grains that are clearly indicative of a Lower Jurassic age, enabling correlation of the strata with the Precipice-lower Evergreen section of the Surat Basin (southern Queensland). Thus the Razorback Beds are considerably older than the early Cretaceous Stanwell Coal Measures with which they have at times been correlated.

INTRODUCTION AND HISTORICAL REVIEW

The Razorback Beds form the dominant physiographic feature in the vicinity of the Mount Morgan mine of central Queensland (Frontispiece). They constitute erosional mountains and are separated by an hiatus of sufficient magnitude to preclude any reciprocal relations with the underlying Palaeozoic structures.

Attention was first focused on this stratal sequence in 1882 after the discovery of auriferous gossan on Mount Morgan. However early geologists (Jack, 1884, p. 3) did not perceive that the auriferous gossan was a product of weathering prior to the deposition of the Razorback Beds and hence unrelated to the present cycle of erosion. Dunn (1905, p. 342) demonstrated unequivocally that the Mount Morgan gossan was older than and unconformable with the Razorback Beds. Subsequently, geological interest has been restricted mainly to the search for ore bodies which may be buried under these Mesozoic strata.

The first reference to the age of this stratigraphic unit was made by A. C. Gregory in a September 1884 address to the Royal Society of Queensland; in this (Gregory, 1885, p. 142), a Mesozoic age was attributed to the Mount Morgan "horizontal sandstones". Within two months, Jack (1884, p. 3) published a paper in which he pointed out that topographical eminences in the Mount Morgan locale were "without hesitation Daintree's 'Desert Sandstone', which I have traced from Torres Straits to Maryborough". Jack further considered that the rocks "present strong Cretaceous affinities", even though Daintree (1872, p. 275) had considered the Desert Sandstone to be of Cainozoic age. Jack & Etheridge (1892, p. 542) accepted Jack's (1884) correlation of the Razorback Beds with the Desert Sandstone. Hence there appears to have been a propensity for the pioneer Queensland geologists to correlate unconformable, near-horizontal sandstone and conglomerate strata with the Desert Sandstone (described by Daintree), regardless of age and detailed lithological considerations.

Dunstan (1898) indicated that the Desert Sandstone capping the Razorback Mountains (his term) in the Mount Morgan area could be traced 14 miles to the northwest as far as Stanwell. He believed the Desert Sandstone to be Upper Cretaceous in age and to succeed unconformably the Stanwell Coal Measures, a rather poorly exposed, sandy and silty unit then regarded as Lower Mesozoic in age. Dunstan noted lithological similarities between the Desert Sandstone and the Stanwell Coal Measures but he attempted to differentiate the two units on structural grounds.

Rands (1900) investigated copper deposits occurring within an area of igneous rocks five miles north of Mount Morgan and half a mile west of Moonmera. He briefly described the cliff-forming sedimentary succession, covering a portion of the metallized rocks, as "a continuation of the Desert Sandstone met with at Mount Morgan and Mount Victoria".

A year later during an examination of mining prospects in the proximity of Mount Morgan, Dunstan (1901, p. 12) reiterated that the formation forming the bold escarpments immediately to the west of the Mount Morgan gold mine was the Desert Sandstone. However on a later inspection, Dunstan (1904, p. 15) departed from earlier published papers when he reported that a correlation could be established between the Stanwell Coal Measures of Lower Mesozoic age and the Moonmera sediments. Inasmuch as the same stratigraphic succession exposed at Mount Morgan can be followed along the unconformity leading to Moonmera, the effect of Dunstan's judgment was tantamount to equating the Mount Morgan Razorback Beds with the Stanwell Coal Measures. Dunstan cited several obscure fossils—*Alethopteris australis*, *Vertebraria media*, *Thinnfeldia indica*, and "*Unionidae* or some allied freshwater mollusc"—from the Moonmera sediments as evidence linking the Stanwell and Moonmera stratigraphic units, although only *V. media* was stated to occur in both. In any case this palaeontological evidence is extremely dubious, in that, as noted by Jones (1947, pp. 44–5), the so-called *V. media* is probably only indeterminate woody material. Dunstan's correlation was also clearly influenced by the apparent stratigraphic continuity between Moonmera and Stanwell in the form of butte-like outliers.

Newman & Brown (in Wilson, 1911, p. 112) ascribed great temporal importance to "perfect fossils of *alethopteris*" recovered from a silty claystone that was being mined for fire-brick manufacture near the base of the Razorback Beds. They claimed that this authenticated a Lower Mesozoic age for the terrigenous clastics in accordance with Dunstan's (1904) chronological evaluation.

In his study of the Ipswich and Walloon floras of Queensland, Walkom (1915; 1917*a*, *b*) indicated close affinity between a form collected from the Stanwell Coal Measures at Stewart's Creek (Fig. 1 shows approximate location) and the species *Equisetites rajmahalensis* Oldham & Morris. The latter was originally described from Indian sediments thought to be of Liassic age; and on this basis Walkom placed the Stanwell Coal Measures in the Walloon Series (Jurassic).

A paper by Reid & Morton (1928), based on field work in central Queensland, assigned the Stanwell Coal Measures to the Triassic-Jurassic interval immediately below the Walloon Series; whereupon Whitehouse (1928, p. 442) argued on palaeontological grounds (obviously he was referring to Walkom's work) that the Measures should be correlated with the lower part of the Walloon Series.

David (1932, p. 81) looked upon the Stanwell Coal Measures as outliers of freshwater Jurassic sediments.

In an important contribution, Whitehouse (1946) described a small fauna of marine pelecypods which had been collected (see Fig. 1 for approximate location) by J. H. Reid from an horizon "apparently . . . within the Stanwell Coal Measures". Of this fauna, Whitehouse regarded two elements, *Iotrigonia limatula* Whitehouse and *Pisotrigonia* sp., as being particularly significant, indicating close relationship with trigoniid assemblages from the Uitenhage and Oomia [Umia] Beds of South Africa and India respectively. Whitehouse regarded his Stanwell fauna as early Cretaceous (Valanginian), not Liassic, in age; and he stated further that Walkom's megaflora from the Stanwell Coal Measures could also be ascribed a Lower Cretaceous age.

Staines (1952) proposed the name "Razorback Beds" for the non-marine sedi-

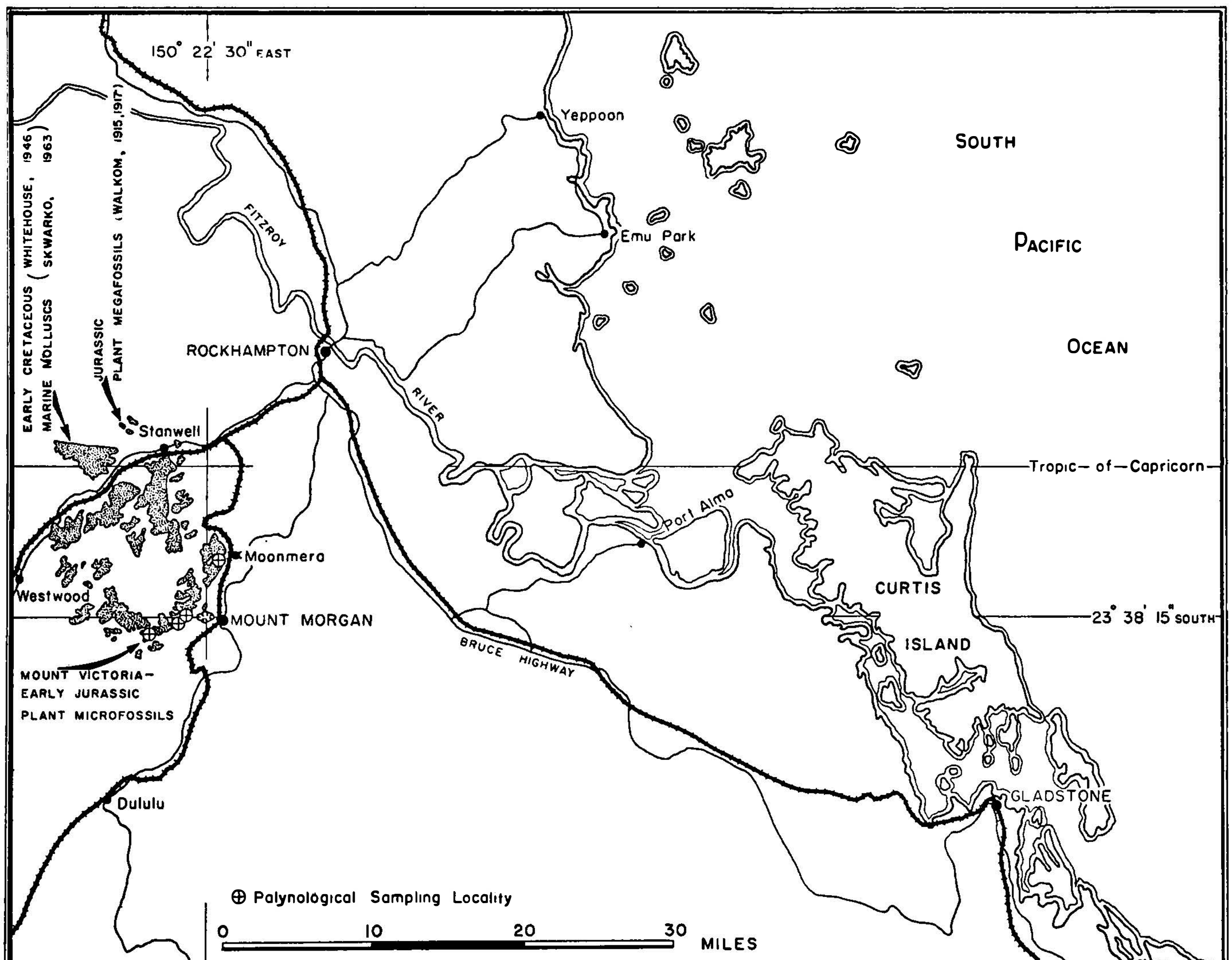

FIG. 1.—Locality and outcrop map of undifferentiated Mesozoic sedimentary rocks, Rockhampton-Mount Morgan district, central Queensland. Lower arrow indicates locality in the Razorback Beds from which Lower Jurassic plant microfossils are here reported. Upper left arrow shows approximate location of marine pelecypods of Lower Cretaceous age, and upper right arrow indicates site of plant megafossils from Stewart's Creek near Stanwell. The geographical coordinates intersecting in the Mount Morgan open cut are centred on the Crown Shaft. All references to mine coordinates are based on this fixed point.

ments forming the Razorback Mountains, extending for 8 miles from Mount Victoria through Mount Morgan to Moonmera. Staines's term replaced the vernacular "Fire-clay Series" which had been used in unpublished reports on the Mount Morgan ore body (e.g. Sir Colin Fraser in 1914). Staines (1952, p. 68) remarked that "as it is thought that there is a connection between these [Stanwell Coal Measures] and the Razorback Beds, the *latter* are probably Cretaceous also". Staines did not discuss the lithostratigraphic aspects of the Razorback Beds in detail nor did he include a measured vertical section; but the name serves as a convenient designation for the non-marine sediments exposed in the Mount Victoria-Mount Morgan-Moonmera environs as distinct from the Stanwell Coal Measures to the northwest.

Dinosaur footprints were discovered by K. A. Moody, V. M. Voss, and C. W. Crane (Mount Morgan Limited surveyors) and reported by Staines (1954) in the first published record of vertebrate fossils from the Razorback Beds. The imprints are exposed in an outlier (Fig. 2) of the Razorback Beds. Staines did not attempt to match footprints or tracks to animals. Dr. J. Cosgriff (1965, oral communication) thought some of the footprints might have been made by theropods.

In a paper on "Australian Mesozoic Trigoniids", Skwarko (1963) described a new species, *Iotrigonia stanwellensis*, from the fossiliferous locality (Fig. 1) in the Stanwell area discussed earlier by Whitehouse. He considered it to be of Neocomian age, thereby substantiating Whitehouse's correlation.

One of us (K.D.C.) discovered an extensive deposit of vertebrate fossils (Mount Morgan Limited mine coordinates 1,400N., 875W.) at the very base of the Razorback Beds which rest on the eroded surface of an Upper Devonian quartz diorite (Fig. 2). These fossils were identified by Bartholomai (1966) as possessing a "remarkable structural similarity to those of the imperfectly known *Leptocleidus superstes* Andrews . . . known only from the Cretaceous of Europe and Africa", and believed to be freshwater plesiosaurians. In the same paper, Bartholomai mentioned plant megafossils taken from silty claystones (Mount Morgan Limited mine coordinates 700S., 4,200W.) 5–20 feet above the unconformity. He identified the flora as "coniferous leaf fragments, tentatively referred to *Elatocladus* sp.; ferns, *Hausmannia* sp. and *Coniopteris* cf. *hymenophylloides;* and a ginkgoalean, *Ginkgo* cf. *digitata*". Bartholomai stated that the plants are not at variance with an Upper Jurassic or Lower Cretaceous age for the Razorback Beds.

In a recent work treating the Mesozoic sediments of the Stanwell-Mount Morgan area, Kirkegaard *et al.* (1966, p. 47) concluded that the sandstones forming the "prominent white cliffs at Mount Morgan" (Razorback Beds) constitute the lower part of the Stanwell Coal Measures, which they list as a Cretaceous unit. In fact, these authors recognize no Jurassic rocks in the area covered by their survey (Rockhampton-Port Clinton 1:250,000 Sheet Areas).

In a volume on Queensland Jurassic fossils, Hill, Playford, & Woods (1966) illustrate several plant megafossils from the Stanwell Coal Measures, including types originally described by Walkom. Although Hill and her co-editors do not discuss the age or correlation of the Stanwell Coal Measures, it is clear that they follow Walkom in regarding the flora as Jurassic in age.

The present paper is the initial record of plant microfossils from the Razorback Beds. The stratigraphic and chronological significance of this discovery is discussed herein and new data are presented on the lithostratigraphy of these non-marine Mesozoic sediments. The palynological analysis was carried out by G. P.; K. D. C. was responsible for the field-work.

STRATIGRAPHY

The Razorback Beds at Mount Morgan consist generally of two conformable parts. The lower third is rarely cross-stratified and comprises interbedded conglomerates, claystones, siltstones, and sandstones, with the last-named predominating. The upper two-thirds of the Razorback Beds consist of predominantly cross-stratified sandstones that are intercalated with silty beds and with laminae of claystone.

The upper surface of this entirely non-marine unit is erosional, and it is not known how much of the original sequence has been removed. The lower contact is unconformable and there is evidence of pre-Razorback erosion of the Palaeozoic rocks (Fig. 2). Typically the basal sediments are sandstones or conglomerates but are frequently claystones around Mount Morgan.

The unconformity is often marked by a distinct break in slope of the topographic profile; thus at Moonmera and elsewhere along the Razorback Mountains the unconformity is situated near the base of a 50- to 100-foot high escarpment. However, where the basal strata are clayey the unconformity is not easily detected as the claystone forms gentle slopes corresponding to the declivity expressed by the Palaeozoic section. The unconformity is best described as a nonconformity in the neighbourhood of Mount Morgan because the older rocks are of plutonic origin and they can easily be traced from Mount Victoria to Moonmera. The dip of the unconformity is less than 1° to the north over the 8-mile distance suggesting that Mesozoic sedimentation was initiated on a mature landscape.

In the vicinity of Mount Morgan the thickness of Razorback Beds varies between 125 and 300 feet. This variation can be attributed mainly to the 125 feet of relief developed locally on the Jurassic peneplain, but differential erosion of the upper surface had some effect. Generally the Razorback Beds are about 150 feet thick as shown in Figure 2, yet small outliers within half a mile of the main body of sediments are strongly denuded—some expose less than 3 feet of the Mesozoic sediments.

At Mount Victoria the Razorback Beds attain an estimated thickness of 300 feet. Carbonaceous claystones and siltstones collected in several drives in the old gold mine at this locality (Weir's Claim; see Reid, 1939, p. 295) yielded a diversified and well-preserved spore-pollen florule as detailed subsequently in this paper. These palynological samples were collected from an horizon 4 feet above the auriferous pebbly sandstone bed and about 100 feet below the summit of Mount Victoria.

Attitude of the strata near the unconformity has been controlled by undulations in the pre-Razorback topography. These initial dips average 1°–3°, seldom exceeding 8°. The stratification of the rocks within 15–20 feet of the unconformity ranges considerably—from thinly laminated claystones to thick-bedded conglomerates. Though infrequent in the basal section, cross-stratified sandstone is well shown in the escarpment at Moonmera, where very thin beds dip 20°–25°. These cross-strata are tabular, medium-scale structures that seldom exceed a length of 20 feet.

In the vicinity of Mount Morgan 80 per cent of the upper Razorback Beds consists of sandstone, of which over half is extensively cross-stratified. Fifteen dip measurements of the cross-stratified sandstones, from an area of about 1 square mile (centred on Mount Morgan Limited mine coordinates 3,000N., 6,000W.), show a general palaeocurrent direction of about N.20°W. The present drainage (i.e. Dee River) shows essentially a direct reversal of that trend.

Notwithstanding the close temporal and spatial relationship which existed between the basal strata of the Razorback Beds and the old soil profiles that were developed on the weathered Jurassic rocks, numerous exposures along the unconformity fail to reveal vestiges of palaeosols.

Reid (1939, p. 295) indicated by a sketch that the Razorback Beds are faulted in the Mount Victoria area. The current work does not confirm this, and it is suggested that the structure interpreted by Reid as a fault is actually a non-diastrophic structure that was formed penecontemporaneously with sedimentation (i.e. intraformational slumping). The pattern of fractures in the Razorback Beds is one of low density, the fractures being vertical, scattered, and occasionally filled with haematite. The vertical attitude of the fractures is compatible with stresses accompanying epeirogenic uplift.

Lithological features

The bulk of claystone is restricted to the basal section of the Razorback Beds and surpasses the volume of conglomerates. Rarely do the basal conglomerates have a thickness of more than 5 feet, whereas the claystone beds are known to exceed 40 feet (Fig. 2).

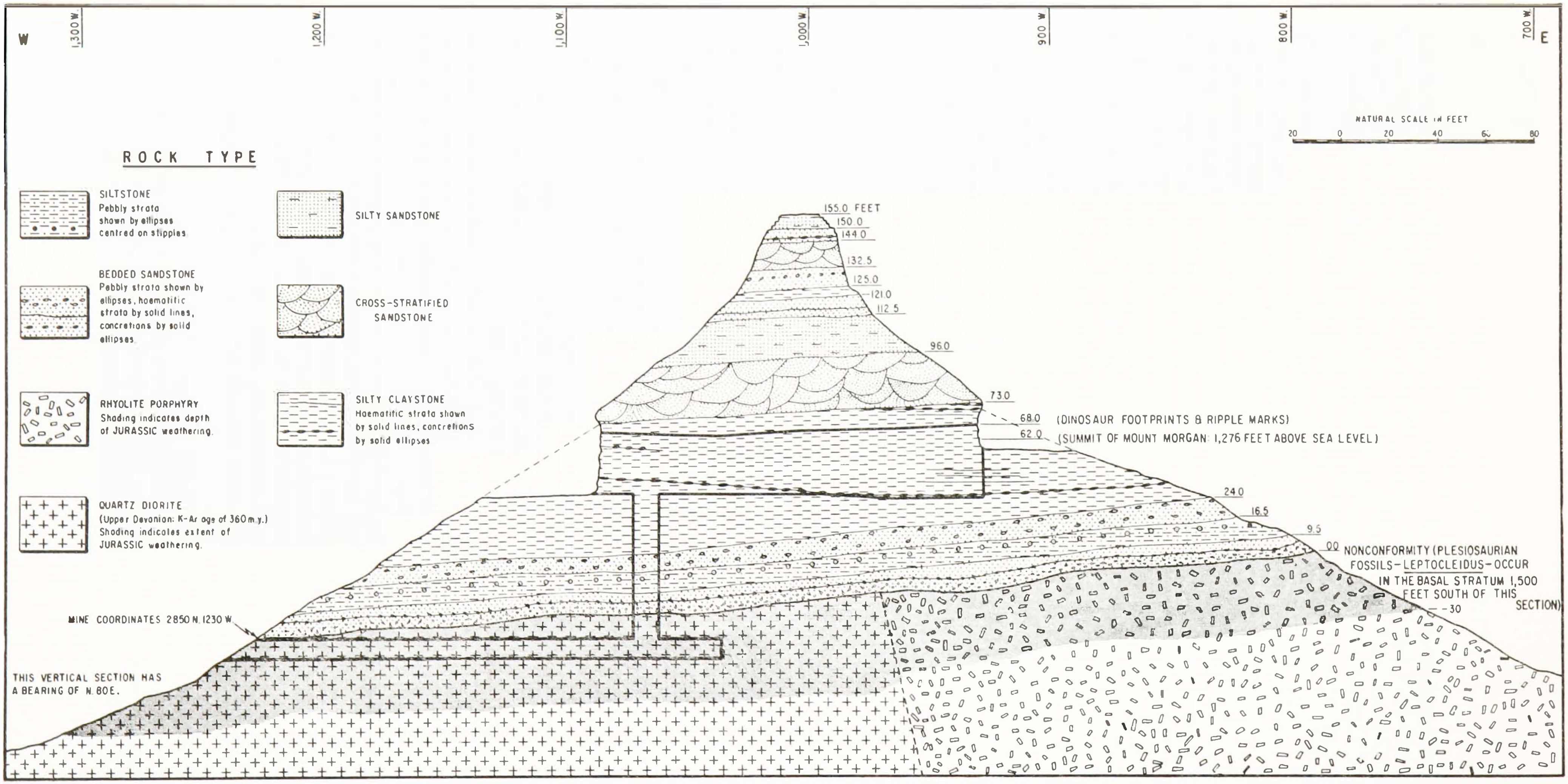

FIG. 2.—Lithostratigraphic vertical section of an outlier of the Razorback Beds. This section is not considered as a type locality because it contains an unusually thick unit of silty claystone. The base of the sequence is not truly conglomeratic here, nor is it in most exposures. This locality presents an unparalleled three-dimensional view of the Razorback Beds, as revealed by extensive mining excavations (delineated by solid lines).

X-ray powder photographs of two claystones from separate lenses revealed that the clay minerals belong to the kaolinite group; probably kaolinite is exclusively represented. Thin-section study shows that the claystones contain about 20 per cent silt-size quartz grains.

The composition of conglomerate lenses has been controlled largely by geographical location in relation to Mount Morgan. For example, a count of 50 pebbles and cobbles from a conglomerate lens 2 feet thick (Mount Morgan Limited mine coordinates 2,650N., 1,150W.) showed that 64 per cent of the gravel comprises quartz cobbles (leached of sulphide) eroded from the Mount Morgan breccia pipe; and that 36 per cent of the coarse pebbles consists of felsite. On the other hand, a count of 50 pebbles from a 4-foot basal conglomerate lens (Mount Morgan Limited mine coordinates 4,250N., 3,200W.) showed 85 per cent of the pebbles to be felsites, 10 per cent quartz cobbles from an unknown source, and 5 per cent rhyolite porphyries. These conglomerate lenses contain minor proportions of authigenic quartz as primary cement. Large quantities of haematite have filled the pores, thus serving as a secondary cement.

The upper section of the Razorback Beds consists largely of protoquartzite sandstones together with minor siltstones and claystones. Recent weathering and leaching of protoquartzite beds high in the succession has purified these sandstones to such a degree that they are classifiable as orthoquartzites. A partial chemical analysis of six of these friable, leached sandstones from a peak in the Razorback Mountains (Mount Morgan Limited mine coordinates 2,300N., 5,500W.) is depicted in Table 1. The silica content is shown to exceed 90 weight per cent; calcium oxide comprises less than 1 weight per cent.

TABLE 1

PARTIAL CHEMICAL ANALYSIS OF SANDSTONES FROM THE RAZORBACK BEDS

Rock	SiO_2%	CaO%	Iron%	MgO%	Al_2O_3%	Au Ounces	Total Weight%
672	92.04	0.2	5.51	0.44	1.02	nil	99.21
673	94.58	0.1	4.93	0.36	0.60	nil	100.57
674	96.24	0.2	2.17	0.36	0.98	nil	99.95
675	94.48	0.3	1.85	0.28	0.93	nil	97.84
676	95.34	0.1	0.85	0.32	1.12	nil	97.73
677	96.34	0.3	1.06	0.34	1.46	nil	99.54

These chemical analyses were performed by the Research Department, Mount Morgan Limited. Nothing of the original samples now remains.

The protoquartzite sandstone cement is dominantly silica with very minor amounts of carbonate. The silica has commonly been precipitated on tangential grain contacts, whereas concavo-convex and straight contacts are scarce. The deficiency of silica cement accounts for the friable nature and high porosity of these sandstones. Authigenic quartz overgrowths were insufficient to restore the symmetry of quartz grains. No "dust rings" or secondary quartz rims were optically distinguishable enclosing an entire grain of quartz. Pettijohn (1957, p. 652) has pointed out that lack of silica cement in a friable sandstone may be accounted for by removal of carbonate cement by leaching. This may be the case with the sandstones typical of the Razorback Beds and which may originally have had a dominantly calcareous cement.

A secondary haematitic cement was introduced in the Razorback Beds much later than the silica. It was commonly deposited by ground water; in places of greater permeability layers of haematite were formed at angles greater than 40° to the primary dip. This cement was deposited in all the lithological units, but principally in the sandstones.

Concretions occur throughout the entire Razorback succession. These epigenetic structures display the usual concentric layers formed by cementation of detrital material by haematite around a nucleus typically of kaolinite. They usually form ellipsoids about 6 inches (rarely as much as 5 feet) along the major axis.

Application of Folk's (1959) empirical classification to a microscopic analysis of the sandstones indicates that the detrital quartz was derived almost entirely from a granitic source. A count of 2,000 quartz grains from ten thin-sections showed that 60 per cent of the grains had straight extinction; 29 per cent had slightly undulose extinction; and the remaining 11 per cent was divided among grains with strongly undulose extinction and semi-composite, composite, and composite metamorphic extinction types. Thus, the available data indicate that the Razorback sediments were swept northwestwards from a granitic plutonic source.

Stratigraphic section near the Mount Morgan Mine

The following is a detailed description of the section of Razorback Beds shown in Figure 2. Representative samples were collected for laboratory study from each lithological unit. Description of each unit combines megascopic and microscopic data and X-ray determinations where applicable. The Goddard Rock-Color Chart was used to standardize colour descriptions of hue, value, and chroma. The Wentworth Scale was employed to classify particle size of sediments. The terms used to portray the stratification and cross-stratification are those defined by McKee & Weir (1953).

The rocks in this section are ruptured by a low-density fracture pattern of near-vertical joints. Approximately one joint per linear foot is encountered along a direction normal to the parallel fractures. Most of the joints trend N.20°-50°E. and some are filled with haematite.

Thickness in Feet		Lithological Characters
From Non-conformity	Of Rock Unit	
155.0	2.0	Protoquartzite sandstone, yellowish grey (5 Y 8/1), friable, fine-grained, fair-sorted, thin-bedded, clayey matrix; dip 3° to S.60°W.
153.0	0.5	Silty claystone, yellowish grey (5 Y 8/1), kaolinitic, micaceous; dip 3° to S.60°W.
152.5	1.5	Protoquartzite sandstone, pale yellowish orange (10 YR 8/6), medium-grained, fair-sorted, rounded felsitic coarse pebbles locally scattered along a very thin bedding plane; dip 3° to S.60°W.
151.0	1.0	Silty claystone, pinkish grey (5 YR 8/1), kaolinitic, micaceous; with a very thin-bedded protoquartzite lens near base; dip 3° to S.60°W.; a very thin-bedded haematitic bed defining lower contact.
150.0	6.0	Protoquartzite sandstone, dark yellowish orange (10 YR 6/6), fine-grained, fair-sorted; near top and bottom of unit very thin-bedded lenses of haematite and ellipsoidal haematitic concretions (up to 2 feet in diameter) parallel the general strata; cliff-former; dip 6° to S.55°W.
144.0	11.5	Protoquartzite sandstone, dark yellowish orange (10 YR 6/6), medium-grained, fair-sorted; siliceous cement with epigenetic haematite staining the quartz particles; haematitic lens and haematitic concretions of varying size parallel bedding surfaces near top of unit; near base of unit the colour changes to a greyish orange (10 YR 7/4) and the grain size is reduced to a fine sand; stratification is very thin-bedded, planar cross-stratified, medium-scale, straight to concave; tabular and wedge-shaped sets dip 22° to N.10°E., and the general strata of the composite sets dip 6° to S.55°W.; graded and cyclic bedding is common in the cross-strata; cliff-former.
132.5	7.5	Protoquartzite sandstone, greyish orange (10 YR 7/4), medium-grained, fair-sorted, kaolinitic matrix; coarse felsitic pebbles scattered along bedding planes in the upper 2 feet of the unit.
125.0	4.0	Silty claystone, pinkish grey (5 YR 8/1), kaolinitic, micaceous, laminated; laminae of epigenetic haematite and limonite discordant to general strata.
121.0	8.5	Protoquartzite sandstone, greyish orange (10 YR 7/4), fine-grained, fair-sorted, thin-bedded; very thin-bedded haematite layer in middle of unit; general strata dip 6° to N.60°W., small-scale tabular cross-stratified strata dip 20° to N.15°W.
112.5	16.5	Protoquartzite sandstone, yellowish grey (5 Y 8/1), micaceous, fine-grained, well-sorted, siliceous cement; haematitic laminae cross general stratification at an angle of 50°; at base of unit a 6-inch layer of haematitic sandstone forms sharp contact with underlying unit.

Thickness in Feet From Non-conformity	Of Rock Unit	Lithological Characters
96.0	23.0	Protoquartzite sandstone, darkish yellow-orange (10 YR 6/6), micaceous near base of unit, fine-grained, well- to fair-sorted, walnut-sized haematitic concretions along several bedding planes; very thin-bedded; planar cross-stratified, small to medium scale, concave, wedge-shaped sets dip 22° to S.80°W., general stratification dip 10° to S.60°W.
73.0	49.0	Silty claystone, medium grey (N7), kaolinitic, carbonaceous, micaceous, thinly laminated; covered in places by thin veneer of kaolinite giving mottled effect; few thin-bedded silt layers; very thin haematitic beds and ellipsoidal haematitic concretions (up to 2 feet in diameter) occur along many bedding planes; oscillation ripple marks and imprints of dinosaur tracks near top of unit; clay used for fireclay bricks.
24.0	7.5	Protoquartzite sandstone, dark yellowish orange (10 YR 6/6), coarse to very coarse grained, poor-sorted, siliceous cement; several interbedded layers of quartzitic and felsitic medium pebbles; a very fine pebbly protoquartzite sandstone, pale yellowish brown (10 YR 6/2) defines base of unit.
16.5	7.0	Siltstone, yellowish grey (5 Y 7/2), very thin to laminated; one thin-bedded stratum with very coarse sand and very fine quartzitic pebbles.
9.5	9.5	Protoquartzite sandstone, dark yellowish brown (10 YR 6/6), poorly developed bedding throughout unit, poor-sorted; very fine to coarse quartzitic pebbles scattered along various levels; haematitic sandstone with quartzitic pebbles forms basal bed; well-defined contact with underlying igneous rock.
		Nonconformity
		Upper Devonian rhyolite porphyry and quartz diorite are weathered to depths of 30 and 40 feet respectively.

PALYNOLOGY

Material and methods

Fourteen samples were collected from four localities for the purpose of palynological investigation. The precise localities are shown in Figure 1, and the stratigraphy has been discussed earlier. Other details relating to the samples are given below.

Sample Number	Locality	Lithology	Preparation Number
L.3161	Mount Morgan Limited (co-ordinates 190S., 3,770W.)	Pale grey-red, haematitic claystone	P448
L.3138	Mount Morgan Limited (co-ordinates 630S., 4,140W.)	Grey claystone	P449
L.3139	Weir's Claim, Mount Victoria	Dark grey, carbonaceous siltstone	B87*
L.3140	Weir's Claim, Mount Victoria	Grey-black, carbonaceous shale with vitrain stringers	B88*
L.3141	Weir's Claim, Mount Victoria	Pale grey siltstone	B89*
L.3142	Weir's Claim, Mount Victoria	Dark grey, carbonaceous, silty claystone	B163*
L.3143	Weir's Claim, Mount Victoria	Dark grey, carbonaceous, silty claystone	P455*, B164*
L.3144	Weir's Claim, Mount Victoria	Dark grey, carbonaceous, clayey, in part sandy, siltstone with vitrain stringers	B165*
L.3145	Weir's Claim, Mount Victoria	Dark grey, carbonaceous, pyritic claystone with vitrain bands	B166*
L.3146	Weir's Claim, Mount Victoria	Grey, silty claystone	B167*
L.3147	Weir's Claim, Mount Victoria	Grey, silty claystone	B168*
L.3148	Weir's Claim, Mount Victoria	Pale grey, carbonaceous, silty claystone with vitrain bands	B169*
L.3149	Moonmera	Grey, carbonaceous claystone	P452
L.3150	Moonmera	Grey, carbonaceous claystone	P453

Conventional laboratory practices were applied in the extraction and concentration of the acid-insoluble microfossils. About 7 grams of each sample were initially broken into small pieces and immersed in cold 50–60 per cent hydrofluoric acid for several days. The residues were then transferred to nickel crucibles and boiled in the same concentration of hydrofluoric acid for about 30 minutes, after which they were treated with warm 10 per cent hydrochloric acid for removal of precipitated fluorides. On average, only 10 minutes' treatment with Schulze solution was necessary for maceration of organic material; this was followed by rapid washing with very weak (1 per cent) ammonium hydroxide and then, repeatedly, with distilled water. The residues were mounted in glycerine jelly as both strew slides and single-spore mounts. All slides were thoroughly sealed with gold-size varnish.

The palynological preparations of all ten samples from the Mount Victoria underground workings, as asterisked above, contain abundant spores and pollen grains in fair to good states of preservation. The remaining samples (not asterisked) proved to be barren of palynological microfossils.

Composition of the assemblage

The ten productive samples yielded microfloras that are virtually identical in terms of generic and specific composition. Hence a consolidated list of forms present is given below (plate/figure numbers in square brackets refer to illustrations in the present paper of Mount Morgan examples):

Acanthotriletes pallidus de Jersey, 1959
Alisporites australis de Jersey, 1962
Alisporites lowoodensis de Jersey, 1963 [Plate II, figs. 11, 12]
Alisporites spp.
Annulispora folliculosa (Rogalska) de Jersey, 1959 [Plate II, fig. 5]
Annulispora microannulata de Jersey, 1962 [Plate II, fig. 6]
Baculatisporites comaumensis (Cookson) Potonié, 1956 [Plate I, fig. 3]
Camarozonosporites sp. [Plate I, figs. 6, 7]
Cingutriletes sp. [Plate I, figs. 13, 14]
Classopollis classoides Pflug emend. Pocock & Jansonius, 1961 [Plate II, figs. 17, 18]
Classopollis simplex de Jersey & Paten, 1964 [Plate II, figs. 15, 16]
Cyathidites australis Couper, 1953
Cyathidites minor Couper, 1953
Cf. *Densoisporites* sp. [Plate I, figs. 15, 16]
Dictyophyllidites harrisii Couper, 1958
Duplexisporites gyratus Playford & Dettmann, 1965 [Plate I, figs. 17, 18]
Foraminisporis tribulosus Playford & Dettmann, 1965 [Plate I, fig. 19]
Foveosporites sp. [Plate I, fig. 11]
Heliosporites sp. [Plate I, figs. 8–10]
Indusiisporites parvisaccatus (de Jersey) de Jersey, 1963 [Plate II, fig. 14]
Lycopodiumsporites austroclavatidites (Cookson) Potonié, 1956 [Plate I, figs. 4, 5]
Lycopodiumsporites rosewoodensis (de Jersey) de Jersey, 1963
Neoraistrickia truncata (Cookson) Potonié, 1956
Neoraistrickia sp.
Osmundacidites wellmanii Couper, 1953 [Plate I, figs. 1, 2]
Perinopollenites sp.
Podosporites sp.
Polycingulatisporites crenulatus Playford & Dettmann, 1965 [Plate II, figs. 1–4]
Polycingulatisporites densatus (de Jersey) Playford & Dettmann, 1965
Polycingulatisporites mooniensis de Jersey & Paten, 1964 [Plate II, figs. 7–10]
Rugulatisporites sp.
Stereisporites antiquasporites (Wilson & Webster) Dettmann, 1963
Stereisporites perforatus Leschik, 1955 [Plate I, fig. 12]
Vitreisporites pallidus (Reissinger) Nilsson, 1958 [Plate II, fig. 13]

Some variation occurs among the various samples in quantitative distribution of the spore and pollen taxa listed above. To illustrate this, Table 2 shows the percentage amounts derived from counts of 250 specimens encountered in a systematic traverse of part of a slide from each of two samples (L.3141 and L.3142).

TABLE 2

PERCENTAGES OF SPORE AND POLLEN SPECIES RECORDED IN COUNT OF 250 SPECIMENS EACH FROM SAMPLES L.3141 AND L.3142

Species	L.3141	L.3142
Alisporites australis	0.4	1.6
Alisporites lowoodensis	2.4	2.8
Alisporites spp.	6.8	12.8
Annulispora folliculosa	0.8	
Annulispora microannulata	3.2	2.0
Apiculatisporis sp.	0.4	
Baculatisporites comaumensis	12.4	3.2
Calamospora sp.	0.4	0.4
Camarozonosporites sp.		0.4
Classopollis classoides	8.8	12.0
Classopollis simplex	0.4	1.2
Cyathidites australis	3.6	2.8
Cyathidites minor	1.6	1.6
Cf. *Densoisporites* sp.	0.4	
Dictyophyllidites harrisii	0.8	
Duplexisporites gyratus		0.4
Foveosporites sp.	1.6	2.0
Heliosporites sp.	2.0	0.8
Indusiisporites parvisaccatus	0.4	0.8
Lycopodiumsporites austroclavatidites	16.8	17.6
Lycopodiumsporites rosewoodensis	0.4	1.2
Neoraistrickia truncata	1.6	1.6
Osmundacidites wellmanii	11.2	4.0
Podosporites sp.		0.8
Polycingulatisporites crenulatus	0.4	2.0
Polycingulatisporites densatus		0.4
Polycingulatisporites mooniensis	2.8	8.4
Stereisporites antiquasporites	2.4	1.6
Stereisporites perforatus	2.4	0.4
Vitreisporites pallidus	1.6	6.8
Indeterminate	14.0	10.4

CORRELATION AND AGE

As summarized by Evans (1966), a comparatively advanced state of knowledge now exists on the spore-pollen sequence in Australia's largely non-marine Mesozoic sediments. This reflects the exceptionally high status attained by palynology as a major biostratigraphic tool of correlation in petroleum-prospective areas of this country. In Queensland, the stratigraphic applications of palynology can scarcely be understated when so much of our understanding of spatial, temporal, and environmental relationships of Triassic and Jurassic sequences has been gained from palynological studies (e.g. de Jersey & Paten, 1964; Evans, 1964).

The sediment under consideration here provides a further example of how restricted occurrences of at best sparsely megafossiliferous material can be correlated precisely on palynological grounds. As discussed earlier the Razorback Beds have hitherto been assigned to various segments of the Mesozoic column, the latest assessment being Bartholomai's (1966) very tentative "Upper Jurassic or Lower Cretaceous", based on plesiosaurian bones from the base of the sequence.

Abundant *Classopollis* among other attributes clearly testifies that the Mount Morgan palynological assemblage is of Jurassic age. Moreover it includes several species which are known to have restricted vertical distribution in the Jurassic System elsewhere, specifically in the Surat Basin of southern Queensland (de Jersey & Paten, 1964). Probably the most notable of these is *Polycingulatisporites mooniensis*, which is prominent in all the samples. According to de Jersey & Paten (1964, p. 8) this form is confined to the Precipice Sandstone and the lower part of the Evergreen Formation in the Surat Basin, and it appears to be a reliable biostratigraphic index for this interval. Two other species of particular stratigraphic importance are *Classo-*

pollis simplex and *Duplexisporites gyratus*. The former has the same vertical distribution in the Surat Basin as *P. mooniensis* and hence supports a Liassic (Precipice-lower Evergreen) dating. *D. gyratus* provides corroborative evidence in that, although extending downwards into late Triassic deposits (Playford & Dettmann, 1965; de Jersey, 1964; Playford, 1965), it apparently does not occur in sediments younger than the lower part of the Evergreen Formation (de Jersey & Paten, 1964, p. 8). Other distinctive Lower Jurassic species represented in the Mount Morgan assemblage are *Foraminisporis tribulosus* and *Camarozonosporites* sp. (see Playford & Dettmann, 1965; Hill, Playford, & Woods, 1966). Worthy of note also is the complete absence of *Tsugaepollenites* spp. and *Inaperturopollenites turbatus* Balme; these two forms are plentiful and seemingly omnipresent in Australian Jurassic sediments of post-lower Evergreen age but have not been recorded from older material.

Thus, in summary, the microfloral association indicates clearly that the Razorback Beds are Lower Jurassic in age and that they can be correlated with the Precipice Sandstone-lower Evergreen Formation of the Surat Basin. In terms of Evans's (1966) palyno-stratigraphic subdivisions, the Mount Morgan sediments are "J1" equivalents. The present record extends further the known distribution in Queensland of early Jurassic non-marine sediments; and enables an upper limit to be placed on the time of mineralization at Mount Morgan.

The relationship between the Razorback Beds and the Stanwell Coal Measures has yet to be resolved by field mapping and no doubt by further palaeontological studies. The sediments from which Whitehouse (1946) and Skwarko (1963) identified Lower Cretaceous molluscs are probably part of the Stanwell Coal Measures, but the plant megafossil evidence from the unit is still infirm. As discussed earlier, Walkom (1915, p. 37) likened his Stanwell flora to that of the Indian Rajmahal Series which has traditionally been regarded as Jurassic (usually Liassic) in age. Spath (1933) identified Neocomian ammonites from the Rajmahal beds, but Indian stratigraphers are still apt to disregard this evidence (see Arkell, 1956, p. 383). The latest biostratigraphic information on these Indian strata stems from Sah & Jain (1965) who described a palynological flora from two localities in the Rajmahal Hills. They reached no firm conclusion as to the age of the Series, viewing it as containing "a sort of transitional flora ranging between Lower Jurassic and Lower Cretaceous"; but in fact they inclined towards a Middle-Upper Jurassic age assignment (Sah & Jain, 1965, p. 286). Many of the spores and pollen recorded by Sah & Jain are not precisely age-definitive, but it should be pointed out that two, *Trilobosporites perverulentus* (Verbitskaya) Dettmann and *Foraminisporis asymmetricus* (Cookson & Dettmann) Dettmann, are unknown elsewhere (e.g. Australia, Canada, U.S.S.R., Argentina) in pre-Barremian sediments; and that another, *Cicatricosisporites australiensis* (Cookson) Potonié, is not indubitably known from rocks older than the Cretaceous (see Dettmann, 1963). Thus these palynological data in fact lend support to Spath's (1933) Neocomian dating of the Rajmahal Series. If, in turn, Walkom's (1915) megaplant correlation with the Indian beds is still accepted, then the Stanwell Coal Measures can likewise be regarded as Lower Cretaceous, in accord with Whitehouse's (1946) and Skwarko's (1963) findings. At this stage, then, it appears that the Stanwell Coal Measures are considerably younger than the Razorback Beds. Moreover, field evidence (e.g. Dunstan, 1898) indicates the existence of a structural break between the two units.

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REFERENCES

ARKELL, W. J. (1956). *Jurassic geology of the world.* London: Oliver & Boyd.

BARTHOLOMAI, A. (1966). The discovery of plesiosaurian remains in freshwater sediments in Queensland. *Aust. J. Sci.* **28**(11): 437–38.

DAINTREE, R. (1872). Notes on the geology of the Colony of Queensland. *Q. Jl geol. Soc. Lond.* **28**: 271–317.

DAVID, T. W. E. (1932). *Explanatory notes to accompany a new geological map of the Commonwealth of Australia.* Sydney: Australas. Med. Publ. Co.

DE JERSEY, N. J. (1964). Triassic spores and pollen grains from the Bundamba Group. *Publs geol. Surv. Qd* **321**: 1–21.

DE JERSEY, N. J., & PATEN, R. J. (1964). Jurassic spores and pollen grains from the Surat Basin. *Publs geol. Surv. Qd* **322**: 1–18.

DETTMANN, M. E. (1963). Upper Mesozoic microfloras from south-eastern Australia. *Proc. R. Soc. Vict.* **77**(1): 1–148.

DUNN, E. J. (1905). The Mount Morgan gold mine, Queensland. *Proc. R. Soc. Vict.* **17**: 341–55.

DUNSTAN, B. (1898). The Mesozoic coal measures of Stanwell and associated formations. *Publs geol. Surv. Qd* **131**: 1–21.

DUNSTAN, B. (1901). Report on some Mount Morgan mines. *Bull. geol. Surv. Qd* **15**: 1–16.

DUNSTAN, B. (1904). Moonmera: its minerals and copper mines, and a study of its rock formations. *Publs geol. Surv. Qd* **195**: 1–66.

EVANS, P. R. (1964). The age of the Precipice Sandstone. *Aust. J. Sci.* **26**(10): 323–24.

EVANS, P. R. (1966). Mesozoic stratigraphic palynology in Australia. *Australas. Oil Gas J.* **12**(6): 58–63.

FOLK, R. L. (1959). *Petrology of sedimentary rocks.* Austin: Hemphill's.

FRASER, C. (1914). Geological report on Mount Morgan mine. Unpublished report to Mount Morgan Gold Mining Company: 1–65.

GREGORY, A. C. (1885). Observations on occurrence of gold at "Mount Morgan", near Rockhampton. *Proc. R. Soc. Qd* **1**: 141–43.

HILL, D., PLAYFORD, G., & WOODS, J. T. (eds.) (1966). Jurassic fossils of Queensland. *Qd palaeontogr. Soc.*, Brisbane.

JACK, R. L. (1884). Mount Morgan gold deposits. *Publs geol. Surv. Qd* **17**: 1–5.

JACK, R. L., & ETHERIDGE, R. (1892). The geology and palaeontology of Queensland and New Guinea. *Publs geol. Surv. Qd* **92**: 1–768.

JONES, O. A. (1947). Ore genesis of Queensland. *Proc. R. Soc. Qd* **59**(1): 1–91.

KIRKEGAARD, A. G., SHAW, R. D., & MURRAY, C. G. (1966). The geology of the Rockhampton and Port Clinton 1:250,000 sheet areas. *Rec. geol. Surv. Qd* **1966/1** (unpublished).

MCKEE, E. D., & WEIR, G. W. (1953). Terminology for stratification and cross-stratification in sedimentary rocks. *Bull. geol. Soc. Am.* **64**: 381–89.

PETTIJOHN, F. J. (1957). *Sedimentary rocks*, 2nd ed. New York: Harper.

PLAYFORD, G. (1965). Plant microfossils from Triassic sediments near Poatina, Tasmania. *J. geol. Soc. Aust.* **12**(2): 173–210.

PLAYFORD, G., & DETTMANN, M. E. (1965). Rhaeto-Liassic plant microfossils from the Leigh Creek Coal Measures, South Australia. *Senckenberg. leth.* **46**(2/3): 127–81.

RANDS, W. H. (1900). Moonmera coal and copper properties *in* Annual progress report of the geological survey for the year 1899. *Publs geol. Surv. Qd* **150**: 1–11.

REID, J. H. (1939). Mount Victoria prospecting area, Mount Morgan district. *Qd Govt Min. J.* **40**: 295.

REID, J. H., & MORTON, C. C. (1928). Central Queensland geological section. *Qd Govt Min. J.* **29**: 384–89.

SAH, S. C. D., & JAIN, K. P. (1965). Jurassic spores and pollen grains from the Rajmahal Hills, Bihar, India: with a discussion on the age of the Rajmahal intertrappean beds. *Palaeobotanist* **13**(3): 264–90.

SKWARKO, S. K. (1963). Australian Mesozoic trigoniids. *Bull. Bur. Miner. Resour., Geol. Geophys., Aust.* **67**: 1–55.

SPATH, L. F. (1933). Revision of the Jurassic cephalopod fauna of Kachh (Cutch), Part VI. *Mem. geol. Surv. India Palaeont. indica, (n.s.)* **9**(2): 659–945.

STAINES, H. R. E. (1952). The geology of Mount Morgan. *Proc. Australas. Inst. Min. Metall.* **166-167**: 47–69.

STAINES, H. R. E. (1954). Dinosaur footprints at Mount Morgan. *Qd Govt Min. J.* **55**: 483–85.

WALKOM, A. B. (1915). Mesozoic floras of Queensland, Part 1. The flora of the Ipswich and Walloon Series.— (a) Introduction, (b) Equisetales. *Publs geol. Surv. Qd* **252**: 1–51.

WALKOM, A. B. (1917*a*). Mesozoic floras of Queensland, Part 1.— continued. The flora of the Ipswich and Walloon Series.— (c) Filicales, &c. *Publs geol. Surv. Qd* **257**: 1–67.

WALKOM, A. B. (1917*b*). Mesozoic floras of Queensland, Part 1.— concluded. The flora of the Ipswich and Walloon Series.— (d) Ginkgoales, (e) Cycadophyta, (f) Coniferales. *Publs geol. Surv. Qd* **259**: 1–49.

WHITEHOUSE, F. W. (1928). Central Queensland geology (letter to Editor). *Qd Govt Min. J.* **29**: 441–42.

WHITEHOUSE, F. W. (1946). A marine early Cretaceous fauna from Stanwell (Rockhampton district). *Proc. R. Soc. Qd* **57**(2): 7–20.

WILSON, J. B. (1911). The Mount Morgan ore deposits, Queensland. *Trans. Instn Min. Metall.* **20**: 89–116.

EXPLANATIONS OF PLATES

Each figured specimen is designated by the preparation/slide number, stage co-ordinates (on Leitz Ortholux microscope no. Mx2188 of the Department of Geology and Mineralogy, University of Queensland), and its registered number (prefixed "Y") in the micropalaeontological collections of the Department.

All figures are reproduced from unretouched negatives at X750 magnification.

PLATE I

FIGS. 1 and 2.—*Osmundacidites wellmanii* Couper, 1953. 1, Proximal focus, preparation B89/30, 39.6 118.8; Y.315. 2, Median focus, preparation B89/25, 33.2 123.1; Y.316.

FIG. 3.—*Baculatisporites comaumensis* (Cookson) Potonié, 1956. Distal focus, preparation B167/2, 32.8 120.9; Y.317.

FIGS. 4 and 5.—*Lycopodiumsporites austroclavatidites* (Cookson) Potonié, 1956. 4, Proximal focus, preparation B89/39, 32.8 119.6; Y.318. 5, Distal focus, preparation B163/15, 37.5 123.2; Y.319.

FIGS. 6 and 7.—*Camarozonosporites* sp. 6, Distal focus, preparation B164/2, 41.9 127.7; Y.320. 7, Proximal focus, preparation B163/7, 38.5 117.0; Y.321.

FIGS. 8-10.—*Heliosporites* sp. 8, Median focus, preparation B164/10, 34.3 121.9; Y.322. 9, Median focus, preparation B163/1, 34.8 119.3; Y.323. 10, Distal focus, preparation B89/11, 37.5 120.6; Y.324.

FIG. 11.—*Foveosporites* sp. Median focus, preparation B89/29, 36.3 116.1; Y.325.

FIG. 12.—*Stereisporites perforatus* Leschik, 1955. Proximal focus, preparation B168/10, 37.5 119.3; Y.326.

FIGS. 13 and 14.—*Cingutriletes* sp. Median foci. 13, Preparation B168/1, 43.8 114.0; Y.327. 14, Preparation B164/1, 38.8 123.6; Y.328.

FIGS. 15 and 16.—Cf. *Densoisporites* sp. Proximal foci. 15, Preparation B89/5, 34.6 114.8; Y.329. 16, Preparation B89/41, 31.0 121.3; Y.330.

FIGS. 17 and 18.—*Duplexisporites gyratus* Playford & Dettmann, 1965. 17, Distal focus, preparation B169/1, 26.4 110.9; Y.331. 18, Median focus, preparation B163/1, 39.6 116.0; Y.332.

FIG. 19.— *Foraminisporis tribulosus* Playford & Dettmann, 1965. Median focus, preparation B163/12, 35.6 117.6; Y.333.

PLATE II

FIGS. 1-4.—*Polycingulatisporites crenulatus* Playford & Dettmann, 1965. 1, Proximal focus, preparation B168/11, 34.8 121.3; Y.334. 2, Distal focus, preparation B168/8, 31.8 117.6; Y.335. 3, Median focus, preparation B168/7, 36.1 119.1; Y.336. 4, Median focus, preparation B89/7, 33.2 116.7; Y.337.

FIG. 5.—*Annulispora folliculosa* (Rogalska) de Jersey, 1959. Median focus, preparation B89/37, 34.8 118.7; Y.338.

FIG. 6.—*Annulispora microannulata* de Jersey, 1962. Distal focus, preparation B168/1, 41.1 118.9; Y.339.

FIGS. 7-10.—*Polycingulatisporites mooniensis* de Jersey & Paten, 1964. 7, Median focus, preparation B89/3, 19.4 122.8; Y.340. 8, Distal focus, preparation B164/3, 30.6 115.1;Y. 341. 9, Distal focus, preparation B89/1, 19.6 117.8; Y.342. 10, Proximal focus, preparation B167/1, 41.5 127.1; Y.343.

FIGS. 11 and 12.—*Alisporites lowoodensis* de Jersey, 1963. Median foci. 11, Preparation B163/3, 52.6 112.1; Y.344. 12, Preparation B163/8, 39.8 121.0; Y.345.

FIG. 13.—*Vitreisporites pallidus* (Reissinger) Nilsson, 1958. Median focus, preparation B89/18, 33.4 119.6; Y.346.

FIG. 14.—*Indusiisporites parvisaccatus* (de Jersey) de Jersey, 1963. Preparation B163/3, 58.8 117.0; Y.347.

FIGS. 15 and 16.—*Classopollis simplex* de Jersey & Paten, 1964. Median foci. 15, Preparation B89/4, 37.6 120.3; Y.348. 16, Preparation B89/26, 31.4 124.3; Y.349.

FIGS. 17 and 18.—*Classopollis classoides* Pflug emend. Pocock & Jansonius, 1961. 17, Median focus, preparation B163/4, 30.4 116.1; Y.350. 18, Three adherent grains, preparation B163/5, 30.0 119.2; Y.351.

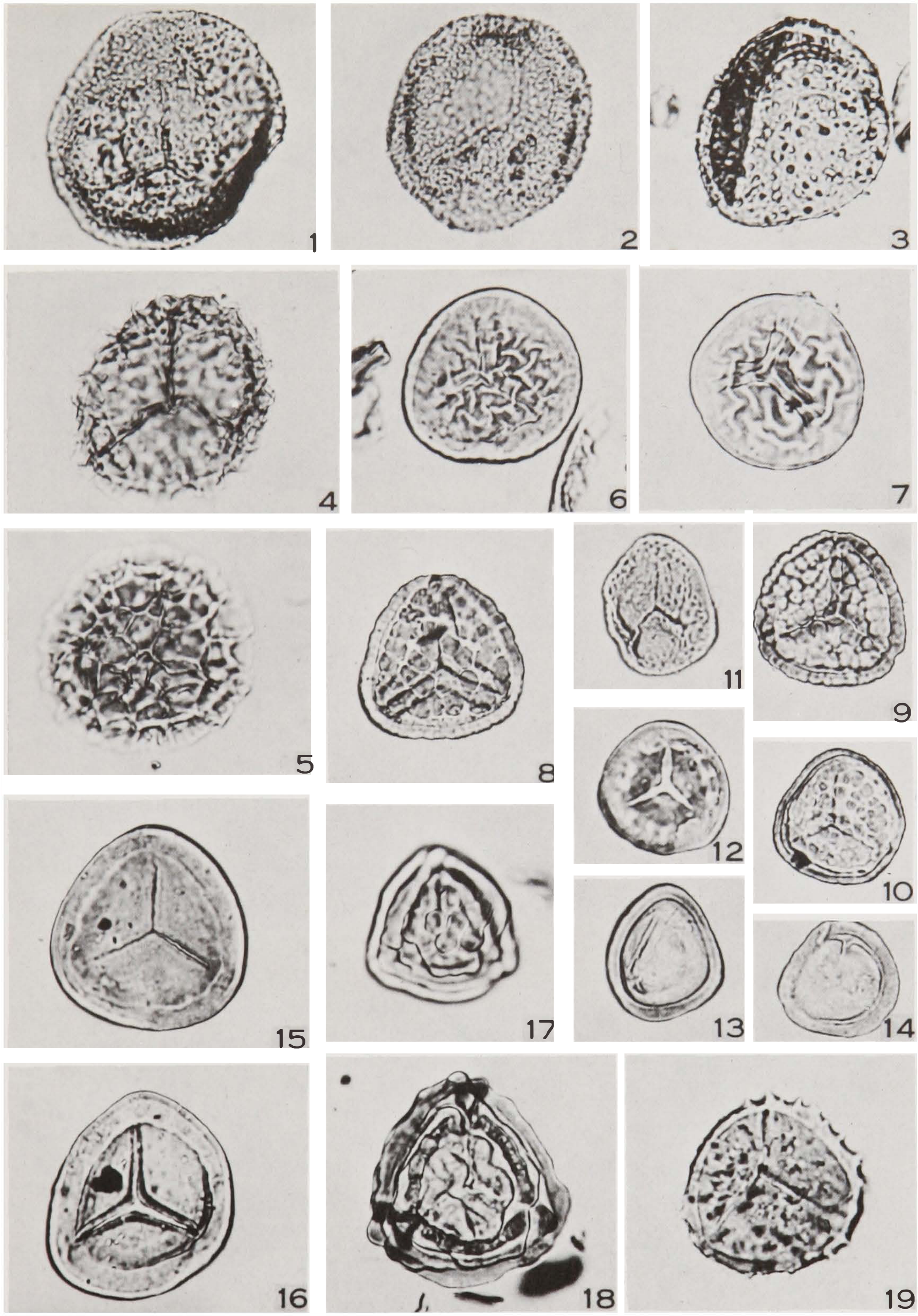

Plate I

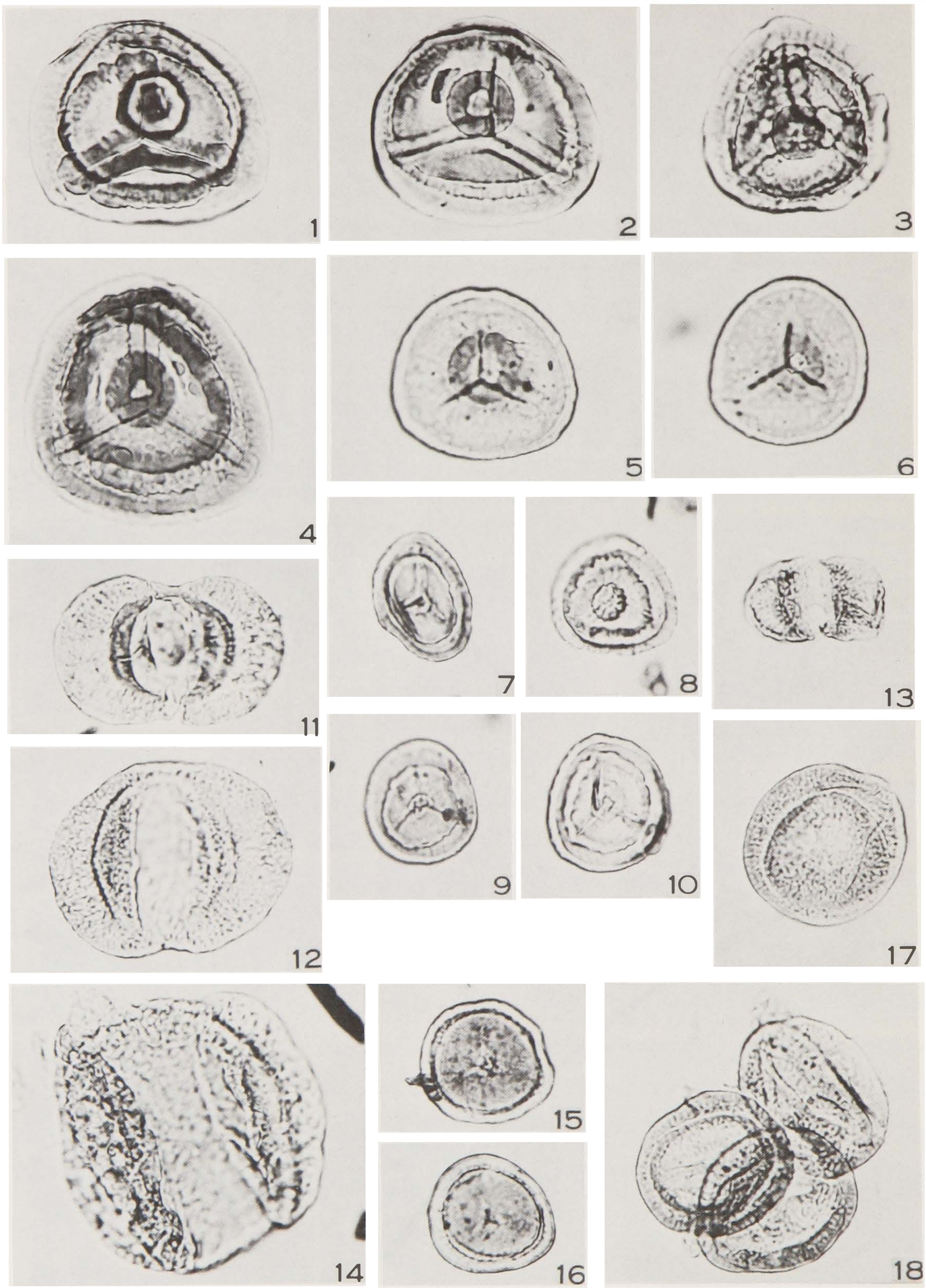

Plate II